IMPROVED TELESCOPE

FIELD OF THE INVENTION

The invention concerns space telescopes and large membranous mirrors.

DESCRIPTION OF THE RELATED ART

PERKINS and ROHRINGER (US 4 093 351), LE GRILL (Fr 2 662 512), and many other authors describe membranous mirrors tied to a rigid structure and stiffened and shaped by means of electric charges.

SILVERBERG, (WO 94/10721), describes a membranous mirror free at his periphery, stiffened by surface charges, and shaped by outside fields created by a rigid support.

BUI-HAI et NHU (US 5 182 512) describes, for use in ultra hight frequency, a mirror obtained by curing a rotating resin.

LENINGRAD PREC MECH OPTI, (SU 1615 655 A) describes a monolithic mirror self shapable made up of two piezoelectric thin plates closely in contact on their whole surface, this mirror being curved overall by a single electrode acting on one of the plates, and locally by discrete electrodes acting on the other plate.

ANDREAS THEODORO AUGOUSTI (GB 2 247 323 A) describes a monolithic mirror self shapable made up of a deformable substrate covered on a face by a reflective surface and on the other face by a network of electrical conductors, the whole being located in a magnetic field with which the currents circulating in the conductors react.

In these two last mirrors the electrodes or conductors in contact with the reflective surface oblige to a high thickness and/or a high rigidity to minimize the surface defects induced by these electrodes or conductors generative of electric and thermal constraints.

None the preceding authors describes or evokes the folding of the mirrors.

OBJECTIVE OF THE INVENTION

The objective of the invention is manufacturing, and folding without residual defect, of a large membranous mirror, particularly of a self shapable mirror, in view of its orbiting.

A portion of a sphere or of a paraboloïd is not a developable surface, and the folding of a concave membranous mirror, without residual deformation after unfolding, is a delicate geometrical and mechanical problem, which will be increased by the presence of electrodes or conductors.

SUMMARY OF THE INVENTION

Membranous mirror 45 and actuating membrane 46.

The objective of the invention is achieved by folding a concave homogeneous membrane without residual defect after unfolding, and by replacing by a membranous mirror 45 and an actuating independent membrane 46 the monolithic self shapable membranous heterogeneous mirror or the association of a rigid frame and a homogeneous membranous mirror of the former art.

The two independent membranes could be thinner and thus foldable more easily and with a

smaller radius of curvature as monolithic self shapable heterogeneous membranous mirror, and the actuating membrane shall be largely lighter than a rigid frame.

The homogeneous membranous mirror will be much less sensitive to folding than a heterogeneous self shapable mirror comprising electrodes and conductors, and the heterogeneous actuating membrane will be able to have residual defects of folding or operation surface defects without harming the quality of the independent mirror.

The objective of the invention is also achieved by manufacturing very thin and very big size membranes, having the surface quality of a liquid and a shape naturally quasi parabolic.

Macro and micro controls. The system, according to the invention, add a short range electrostatic action between membranous mirror 45 and independent actuating membrane 46, to only long range external electromagnetic action of the prior art (ANDREAS THEODORO AUGOUSTI e.g).

The actuating membrane 46 has only an approximate shape, and the final shape is given to the membranous mirror 45 by the electrostatic forces existing between the conducting surface 74 of the membranous mirror 45 and electrodes 75 present on independent actuating membrane 46 (fig 27).

In this manner, important local distorsion of the actuating membrane 46 will not prevent getting a perfect shape for the independent membranous mirror.

Folding. For their folding, the concave membranes 45 and 46 are made quasi plane by the formation of concentric circular undulations, and the quasi plane one thus obtained rolled up on itself according to a diameter.

Manufacturing. To obtain directely a quasi parabolic shape and a good surface, the membranous mirror 45, the actuating membrane 46, and possible protecting membranes 67, are manufactured by spreading a liquid film 64 which hardens on the surface of a liquid 61 contained in a circular container 62 rotating around a vertical axis.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 14, 15- Détails of membranous mirror and actuating membrane tied on rings 82 and 83

Fig. 18, 19, 20- Folding of mirror and membrane

Fig. 27- Cut away view of membranous optical device

Fig. 31, 32- Manufacturing membrane on rotating liquid.

Fig. 36, 37- Ring and handle for handle the membrane.

Fig. 38- Membrane with downward flanges.

Fig. 39- Membrane with upward flanges.

Fig. 40- Details of a central flange.

Fig. 41- Membrane with downward flanges.

Fig. 43- Cut away views of membranous miror 45, actuating membrane 46 and protecting membrane 67 tied on cylindrical device 96, parallel and back to back membranes

DETAILED DESCRIPTION

Membranous optical device. Figures 27 and 43 show cut away views of a concave membranous mirror 45, of a concave actuating membrane 46, and of a concave protective membrane 67, associated with a cylindrical element of connection 96.

Figure 43 shows parallel and back to back arrangements of membranous mirror and actuating membrane.

Figure 43 more particularly shows a connection carried out by central flanges 45.4 and 46.4.

Figures 14 and 15 show a connection carried out by rigid directional rings 82 and 83.

Figure 27 shows an electrode 75 pushing back or attracting the membranous mirror 45 locally.

The metallised surface of the mirror 45, or any conducting surface, should the reflective surface be dielectric, will initially be at 0 potential.

Electrodes 75 of the actuating membrane 46 are set at positive or negative potentials, and as a result, decrease or increase the relative distance between mirror and actuating membrane.

In this manner, an important local distorsion of the actuating membrane 46 will not prevent getting a perfect shape for the mirror.

The actuating membrane 46 is locally covered, by means of the former art, with a thin structure identical to that of an integrated multilayer circuit having conducting, insulating or semi conducting elements, contiguous or superimposed.

Electrical supply of these surfaces designs is provided by surface conductors linked to a power supply through the center of the membrane.

These surface designs IC allows, through the use of a capacitive coupling between the membrane and the mirror, a self control of the distance between mirror and membrane, and consequently the stabilization of the shape of the membranes without the intervention of the central system.

Protecting membrane (Fig. 27, 43). One or several parabolic membranes 67 and 67.1, having flanges 65.8 raised above mirror 45, are located behind actuating membrane 46.

These membranes are made of a fibrous structure impregnated with resin, the fiber being preferentially oriented parallel to the surface of the membrane, according to former art.

Mirror and membrane folding (Fig. 18, 19 and 20). The mirror 45 and the actuating membrane 46 are made totally or in part of a material with shape memory.

After manufacturing, the mirror 45 and the membrane 46 are distorted in such a way that this distorsion is retained until new conditions appear, that brings back the initial shape.

The membranes are concave; if one pushes (Fig. 18) the bottom of the concavity, at its center and perpendicularly to the tangent plane, it results a symmetrical circular distorsion which will intrude into the concavity.

Examination of this previously concave surface then reveals a concave peripheral ring and a

central convex surface.
This central convex surface is equally pushed in the same conditions as before, and a new element of concave centered surface can be seen.
Pursuing with the creation of alternately concave and convex surfaces, one obtains a surface resembling a series of circular, centered waves (Fig. 18, 19, and 20).
The thickness of this folding can be small as one wishes. It only requires an increase in the number of waves.
Once these waves fixed according to proper physical conditions, the almost flat object so obtained can be first scrolled lengthwise and then rolled in a circle.
Manufacturing membranes
All the means of former art making it possible to deposit a thin film on a support can be used to manufacture a membrane, if the thin film can be withdrawn from the support.
First preferred implementation (Fig. 31).
An horizontal container 62 rotating smoothly around a vertical axis contains liquid 61.
A small amount of one or several liquids 64 is poured over liquid 61all the way to the edge 63 of container 62.
This new liquid will wet the edge 63 and will solidify by spontaneous or induced curing, by evaporation, or by any other means of prior art, thereby creating a membrane 46.
Second preferred implementation. The membrane 46 is created by a gaz that solidifies directly onto the surface of the main liquid 61.
Thirth preferred implementation (Fig. 32). The surface of the main liquid 61 is first covered with a film 66 that became an intermediary membrane 66 onto which the liquid 64 is added or on which are brought one or several materials that immediately harden to create membrane 46.
Reflecting layer. A reflecting medium is put on the membrane while it is still on the rotating liquid 61.
Handling the membrane. (Fig. 36 and 37). The edge 63 of the circular rotating container 62 is surmounted and in contact with a ring 90 having handling means 91, such as handles allowing this ring to be grabbed and taken away from the edge.
The membrane 46 created when the film 64 solidifies, will stick the ring 90 thereby allowing this handling.
Flanges. (Fig. 38, 39, 40, 41). The outside wall 92 of the container is a surface of revolution.
The membrane 46 extends (fig. 38), by means of former art, with equal or greater thickness, on the outside wall 92 of the container, previously coated with a non sticking product, and in so doing creating a peripherical flange 46.3 that increases the stiffness of this periphery, thereby allowing it to recover better and faster its original shape.
It ends with a thicker band allowing handling.

In a variation (Fig. 39), the membrane extends on the inside wall of the container in the shape of a flange 46.8 higher than the rotating liquid.

The container 62 has a central circular hole 93 limited by a wall 94 holding the liquid.

The external surface 93 of wall 94 (facing the axis) has the shape of a cylindrical or conical surface of revolution.

The membrane 46 is extended, with increased thickness, on the external surface 93, in so doing creating an annular central flange 46.4 (Fig. 40).

In a variation (Fig. 39), the membrane is extended by a flange 46.9 in the inside surface of the wall 94 of the container and therefore raised above the rotating liquid.

In another variation (Fig 41), the membrane extended on the inside surface of the wall of the container, goes down, along this wall, in the central opening, creating a double flange 46.10.